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# Pediatric Traumatic Brain Injury and the Effect on Academic And Psychosocial Functioning in School Aged Children: A Pilot Study

Mary Ellen Henigan

*Philadelphia College of Osteopathic Medicine, [meghenigan@comcast.net](mailto:meghenigan@comcast.net)*

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Philadelphia College of Osteopathic Medicine

Department of Psychology

PEDIATRIC TRAUMATIC BRAIN INJURY AND THE EFFECT ON ACADEMIC  
AND PSYCHOSOCIAL FUNCTIONING IN SCHOOL AGED CHILDREN:  
A PILOT STUDY

By Mary Ellen Henigan

Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Psychology

August 2017

PHILADELPHIA COLLEGE OF OSTEOPATHIC MEDICINE  
DEPARTMENT OF PSYCHOLOGY

Dissertation Approval

This is to certify that the thesis presented to us by \_\_\_\_\_  
on the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, in partial fulfillment of the  
requirements for the degree of Doctor of Psychology, has been examined and is  
acceptable in both scholarship and literary quality.

Committee Members' Signatures:

\_\_\_\_\_, Chairperson

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_, Chair, Department of Psychology

## **Acknowledgements**

I would like to thank the wonderful individuals who guided and supported me through this challenging yet empowering experience. I first want to thank my dissertation committee. Dr. Kate Tresco, thank you for your patience, expert guidance, and commitment to this project. Your insight gave me focus and clarity. Dr. Kendorski, your expertise on concussions gave me the direction to move on the right path. To Dr. Marvin Rosen, my mentor and friend for the last 8 years, thank you for the many hours you spent guiding me on the components necessary to implement a worthwhile study.

To my children, Patrick, Timothy, and Madelyn, your support and love have allowed me to pursue this dream. Additionally, Timothy, I thank you for the endless hours you spent improving this document. You are three amazing people and I am blessed and proud to be your mother. To the rest of my family, thank you for your belief in me. I love you.

### **Abstract**

The academic and psychosocial functioning of 20 post-TBI high school students were investigated in this pilot study. Participants included 12 males and 8 females ranging in age from 14 to 18 years. The students demonstrated a higher number of discipline referral post-TBI ( $d = 0.82$ ) with a large effect size. Correlational analysis revealed a relationship between pre- and post-TBI, rate of attendance, and GPA. Thirty percent of student participants identified a level of significant elevation on the BASC-3 or BYI-II, most commonly social stress, depression, and sense of inadequacy. One hundred percent identified a change to their academic functioning, social life, or mood post-TBI, as recorded on the self-report survey designed for the study. The most reported changes were lowered grades, difficulty focusing, less social interaction, decreased mood, quicker to anger, and feeling anxious and stressed.

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## **Chapter 1: Introduction**

A concussion is a form of mild traumatic brain injury (TBI), defined by the Centers for Disease Control and Prevention (CDC) as a complex pathophysiologic process resulting from direct or indirect traumatic biomechanical forces to the head (Bompadre et al., 2014; Rivera, Roberson, Whelan, & Rohan, 2015). Recent findings suggest that TBI can be equally debilitating in children and adults, or even more problematic in children because it disrupts typical brain development (Hale et al., 2011). Pediatric TBI occurs most commonly following a sudden external force to the skull, leading to disruptions of underlying brain matter from linear displacement, which can cause focal damage such as contusions, hemorrhages, or intracranial rotation that may result in diffuse injury such as axonal shearing or edema (Donders & Strom, 2000). In childhood, TBI is a common cause of death or acquired disability that is responsible for global health, social, and economic problems. Annual prevalence rates for TBI in childhood are estimated to be in the region of 250 per 100,000 of the population (Hale et al., 2011). Of these, 84% are classified as mild. An estimated 475,000 TBIs occurred annually among children aged 0 to 14 in the United States from 1995 to 2001 (Langlois, Rutland-Brown, & Thomas, 2006).

The prevalence, cause, and nature of childhood head injury appear to vary with respect to age, gender, and the psychosocial context of the child. It has been documented that the prevalence of TBI increases with social deprivation, though most injuries are sustained in road accidents that occur irrespective of social deprivation (Trenchard, Rust, & Bunton, 2013). Further, children who experience head injuries often have other, preexisting influences on their psychological well-being (Anderson & Yeates, 2007). For

example, age at injury, socioeconomic status (SES), developmental disorders such as attention deficit hyperactivity disorder (ADHD) and learning disability, and post-injury environment have been found to be mediators of emotional outcome following a TBI (Luis & Mittenberg, 2002).

### **Functional Impairment**

An estimated 90% of TBI patients who are treated and released from the emergency room are categorized as having mild injury on the basis of initial medical evaluation (Langlois et al., 2006). Although most children with mild TBI are expected to recover fully, in some, functional deficits may persist (Langlois et al., 2006). Early and late symptoms including impairments of memory and attention, headache, and alteration of mental status are the result of neuronal dysfunction caused mostly by functional rather than structural abnormalities (Signoretti, Vagnozzi, Tavazzi, & Lazzarino, 2012). Behavioral and emotional symptoms experienced after TBI may include depression, anxiety, and impaired social communication (Dams-O'Connor & Gordon, 2013). In addition, social isolation, posttraumatic stress, impulsivity, agitation/aggression, and apathy have been reported. When TBI survivors become aware of the functional consequences of their deficits, they can experience feelings of anxiety, frustration, failure, and helplessness (Barlow, 2016). The loss and sadness that can accompany this process may influence motivation for treatment, participation in the community, and maintenance of social support networks (Dams-O'Connor & Gordon, 2013; Massagli et al., 2004). Because these subjective, poorly defined symptoms overlap with neuropsychiatric and medical conditions, their etiologies are controversial and are often considered to be psychiatrically based (Jantz, Comerco, Canto, & Pierson, 2015).

Although each child who has incurred TBI displays a unique constellation of behaviors, commonalities exist (Harvey, 2002). Post-TBI, some students are reported to be lazy, unmotivated, and to have trouble inhibiting irritating or explosive behaviors. Such students are unable to change behaviors in response to contingencies and require classroom interventions (Harvey, 2002). Cognitive consequences of TBI include reductions in intellectual ability, executive function, speed of response, language processing, and visual-perceptual skills (Glang et al., 2008). Memory disorders are also a common and persistent psychological consequence of TBI (Signoretti et al., 2012). These deficits may adversely impact children's capacities to interact with their environments, resulting in increased gaps between the abilities of injured children and those of their peers (Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2001). Academically, deficits can be found in many domains including reading, mathematics, and writing. Despite these diverse and sometimes divergent findings, there have been few attempts to provide an adequate control group as a basis for comparison (Barlow, 2016). For some children injured at young ages, the full effects of injury may not be evident until later, when they are expected to demonstrate increased competence in executive functions and sophisticated reasoning skills (Barlow, 2016).

Long-term follow-up studies conducted during the K-12 school years suggest that difficulties associated with TBI tend to persist or worsen as affected children progress through their education (Glang et al., 2008). Regardless of performance on standardized academic and neuropsychological tests, everyday school-based outcomes are generally poor after pediatric TBI (Arnett et al., 2013). Students with TBI challenge educators with idiosyncratic learning and behavioral profiles that, in many cases, change over time in

response to developmental changes and increased academic and behavioral changes (Glang, Tyler, Pearson, Todis, & Morvant, 2004). As a result, the performance of a student with TBI may fluctuate widely from week to week or day to day across settings or various types of tasks. Tracked over time, the student may appear to take one step forward, two back, reach a learning plateau, and then unexpectedly make a series of gains (Glang et al., 2004). Consequently, strategies for promoting reentry to school must be flexible and highly customized to fit the individual child (Deidrick & Farmer, 2005).

### **School-Based Supports**

Many children return to school full-time within the first month after a TBI that required medical attention (Barlow, 2016). In some cases, school reentry is more difficult than anticipated because of lingering physical, cognitive, and behavior problems. Without adequate support, children who sustain TBIs are at greater risk for grade failure and retention (Deidrick & Farmer, 2005). Additionally, teachers and parents report persistent and long-lasting concerns about the school performances of children who return to their classrooms full-time after TBIs (Deidrick & Farmer, 2005). Surprisingly, in a recent survey of educators working with students with TBI, an overwhelming 92% reported having no training in the academic ramifications of TBI (Glang, Todis, Sublette, Brown, & Vaccaro, 2010).

Students with TBI have been eligible to receive special education services under the Individuals with Disabilities Education Act (IDEA) since 1991 (Glang et al., 2004). Twenty-four states added the category by 1993 with 10 additional recognizing the category by 2001. Despite eligibility, students with TBI continue to be underserved and under-identified for educational supports. School systems erroneously consider TBI a

“low incidence disability” (Glang et al., 2004). Due to this under-identification and inaccurate designation, an accurate count of students with special education needs resulting from TBI is currently unavailable (Glang et al., 2010). With this in mind, the counts that are available raise questions about the current practices for special education identification for students with TBI and the appropriateness of educational programs being provided to these students (Glang et al., 2010).

The goal of education for students with TBI is to ensure academic and social success. The success of the student will depend on many variables, such as the severity of the injury, the anatomical site of the injury, age of the student at the time of injury, and academic achievement prior to injury, as well as familial issues (e.g., family stability, family coping style; Arnett et al., 2013). These variables will have an impact on the academic and social success of the student (Barlow, 2016). The interventions selected for these students must be grounded in a firm understanding of the specific effects of the brain injury on each student’s current level of functioning and approach to learning (Glang et al., 2004).

Supporting children as they return to school, regardless of the time post-injury, is key. It is critical that parents and the child talk to the school before the child returns (Barlow, 2016). Because of the changing nature of abilities and demands, students with TBI require a more comprehensive tracking system than is in place for students with other disabilities (Glang et al., 2004). Researchers and school staff document that students with TBI display behavior characteristics that are significantly different from other students. The selection of interventions for these students must be grounded in a firm understanding of their functional and cognitive needs (Glang et al., 2004, Hale et al.,

2011). Generally, it is recommended that exemptions from assignments be made when possible so that the student does not have to catch up on all assignments or work missed; instead, priority projects or key assignments should be identified (McGrath, 2010).

Exemptions from examinations and tests should be made during the first phase of return to school, and accommodations such as a quiet environment for taking test should be arranged. A gradual return to full participation is recommended (Barlow, 2016).

### **Statement of the Problem**

Critical review of the literature describing the psychosocial effect of pediatric TBI often indicates inconsistent results (Trenchard et al., 2013). This arises due to the methodological limitations of the research and the heterogeneous populations studied. In addition, there has been little attention paid to the emotional and psychiatric manifestations of TBI (Ellis et al., 2015). Research designs with sound methodologies that investigate the contributions of both biological and environmental factors to social outcomes following TBI are minimal (Rosema, Crowe, & Anderson, 2012). Research looking directly at friendship quality and social outcomes following TBI is sorely needed (Ross, McMillan, Kelly, Sumpter, & Dorris, 2011). Furthermore, longitudinal research is needed to determine whether cognitive and affective markers of risk predict a relatively poorer social trajectory (Ross et al., 2011). The incorporation of observational measures in the naturalistic setting and the gathering of multi-informant perspectives, such as that of teachers, is currently undocumented (Mealings, Douglas, & Olver, 2012). This information is necessary before conclusions regarding social functioning in children with TBI can be made with confidence (Ross et al., 2011). Additionally, to establish the future risk of developing psychiatric disorders after TBI, future studies should use

standardized psychological assessment tools to provide comprehensive assessment of pre- and post-injury mental health, psychosocial stress, family functioning and SES (Trenchard et al., 2013). The present study sought to fill some of the gaps noted in the literature.

### **Purpose of the Study**

The purpose of this study was to critically evaluate the cognitive, academic, and psychosocial functioning of high school students post-TBI. The following three research questions were investigated: (a) What is the relationship between TBI and cognitive and academic functioning of high school students? (b) What is the relationship between preexisting psychosocial, biological, and environmental conditions and student functioning post-TBI? and (c) What are the educational and psychosocial needs of the post-TBI student?



## **Chapter 2: Literature Review**

Current research is lacking in regard to the educational outcomes of children with TBI. Objective measures of educational performance, including pre-injury cognitive and academic functioning, are not well described (Arnett et al., 2013). There are relatively few published studies in which students have been invited to share their experiences and perspectives of the school experience following TBI (Mealings et al., 2012). To better understand the nature and concerns regarding TBI in the school, it is first important to review the relevant literature, including prevalence rates, head injury classifications, and functional impairment in education and psychosocial functioning.

### **Prevalence**

In childhood, TBI is a common cause of death or acquired disability that is responsible for global health, social, and economic problems (Trenchard et al., 2013). There are common patterns of brain pathology resulting from TBI, both macroscopic and microscopic. It is known that children who suffer TBI are not representative of the general population (Anderson & Yeates, 2007). It has been documented that the prevalence of TBI increases with social disadvantage (Trenchard et al., 2013). Notably, affected children have a higher incidence of behavior difficulties and impulsiveness and come from families in which parent neglect and poor supervision are evident. They are more likely to have preexisting behavior, learning, and, often, other influences on their psychological well-being (Trenchard et al., 2013). In fact, age at injury, severity of injury, lower SES, poor family functioning, and pre-injury adaptive functioning, developmental disorders such as ADHD and learning disability, and post-injury environment have been found to be mediators of emotional outcome following a TBI

(Luis & Mittenberg, 2002).

The consequences of childhood TBI have been researched widely, with the literature suggesting that deficits are observed acutely and long-term across neuropsychological and psychosocial domains. Reported outcomes appear highly variable, ranging from full recovery, persisting and severe impairment, absence of impairment initially with emerging problems over time, and early slowed development with catch-up over time (Trenchard et al., 2013). One of the most prevalent cognitive deficits following TBI is memory impairment, which substantially affects a child's ability to learn and retain information, skills that are essential for success in school. Memory impairments have been documented in both mild-moderate and severe injuries (Lajiness-O'Neill, Erdodi, & Bigler, 2010). The difficulty in managing TBI is that there is currently no way to predict accurately and prospectively what each individual's trajectory will be (Master, Gioia, Leddy, & Grady, 2012). The nature, type, and severity of brain injury affect the outcome and long-term sequelae associated with TBI in children (Semrud-Clikeman & Bledsoe, 2011).

### **Classifications of Head Injury**

**Types of head injury.** Head injury fall into two types: closed and open. Closed head injuries, which comprise approximately 90% of all head injuries, may occur when the child is stationary and struck in the head with a moving object (i.e., coup injury). The more common type of closed head injury is caused when a child is in motion and the head strikes a surface such as a windshield or a pavement (E. Clark, 2006). The cause of the closed head injuries is the result of acceleration and deceleration forces that may or may not involve impact with the skull. Closed head injuries may involve either diffuse or

focal damage. The primary brain injury may be at the site of the impact (i.e., coup injury) or the site at the point opposite the impact (i.e., contra-coup injury; Hale et al., 2011). In contrast, an open head injury involves a wound that is caused by an outside material that enters the brain, such as a knife or bullet. Open head injuries are rarer in children and adolescents. These cases are often lethal, as there is a 90% death rate in the case of gunshot wound (E. Clark, 2006). The damage is often more focal, impacting the areas along the line of penetration (Semrud-Clikeman & Bledsoe, 2011).

**Levels of head injury.** A TBI is classified as mild, moderate, or severe based in initial Glasgow Coma Scores (GCS). GCS is the most commonly administered measure of consciousness (Guilliams & Wainwright, 2016). GCS assesses an individual's response to stimuli with eye opening, motor movements, and verbal responses, with scores ranging from 3 to 15 (Teasdale & Jennett, 1974). The level of consciousness and response is predictive of recovery and disability. A higher score is less indicative of injury. A brain injury is considered mild when an individual has a GCS between 13 and 15 and a loss of consciousness (LOC) less than 1 hour, posttraumatic amnesia (PTA) of less than 24 hours, and no abnormalities on computed tomography (CT) or magnetic resonance imaging (MRI) scans (Catroppa & Anderson, 2007). This definition of a GCS as either mild or moderate has been debated in pediatric and adult literature (Guilliams & Wainwright, 2016). Mild head injuries may be accompanied by headache, lethargy, irritability, withdrawal, and/or lability. Research has generally not supported long-term neuropsychological deficits resulting from mild injury (Semrud-Clikeman & Bledsoe, 2011). Most of the children with mild TBI who have persistent difficulty have also had prior problems or prior TBIs (E. Clark, 2006).

For a brain injury to be considered moderate in severity, there must be a GCS of 9 to 12, loss of consciousness, and PTA that lasts from 1 to 24 hours. Children with moderate TBI are often difficult to distinguish from those with mild TBI since neither group has been shown to have persistent brain injury sequelae (Catroppa & Anderson, 2007; E. Clark, 2006). The symptoms include headaches, dizziness, fatigue, confusion, irritability, sleep disturbance, inattention and poor concentration, and memory problems (Catroppa & Anderson, 2007). Severe head injury involves a loss of consciousness or PTA for more than 24 hours with a GCS of 3 to 8. Severity of injury as measured by GCS or loss of consciousness has consistently been reported to be related to initial and long-term cognitive sequelae, including memory impairment. Children who have sustained a severe TBI have been shown to have the worst outcomes across cognitive, physical, social, and behavioral domains (Guilliams & Wainwright, 2016; Lajiness-O'Neill et al., 2010).

### **Impairment**

**Neurological impact.** Recent findings suggest that TBI is more problematic in children because it disrupts typical brain development (Glang et al., 2004). Research on neurobehavioral recovery and the capacity of the brain for repair after TBI is particularly important in children because the abilities that support the acquisition of behavioral and academic skills are developing (Gil, 2003). Pediatric TBI results most commonly from a sudden external force to the skull, leading to disruptions of underlying brain matter due to linear displacement that can cause focal damage, such as contusions, hemorrhages, or intracranial rotation that may result in diffuse injury such as axonal shearing or edema (Donders & Strom, 2000). A number of factors determine the likelihood that

impairments will result from the injury; however, the most important factor is the type of damage (i.e., primary and secondary; E. Clark, 2006). Primary damage is caused by the rupturing of the blood vessels (hemorrhage), bruising (contusions), fracture of the skull, and stretching or shearing of nerve pathways (axonal injury). Secondary damage includes swelling caused by accumulated blood and cerebrospinal fluid, increasing intracranial pressure and blood flow, reduced oxygen, and tissue death (Donders & Strom, 2000; Hale et al., 2011). As stated previously, one of the most prevalent cognitive deficits following TBI is memory impairment.

**Post-concussive syndrome.** Post-concussive syndrome (PCS) is a controversial constellation of cognitive, emotional, and physical symptoms that some patients experience following a mild traumatic brain injury (Garden & Sullivan, 2010). PCS is listed in both the *ICD-10* and *DSM-IV-TR* (American Psychiatric Association [APA], 2000; World Health Organization [WHO], 1993). The diagnostic criteria for PCS in the *ICD-10* includes a history of head trauma with a loss of consciousness preceding symptom onset by 4 weeks (Friedland, 2015; WHO, 1993). In addition, there needs to be symptoms in three or more of the symptom categories: headache, dizziness, malaise, fatigue, or noise intolerance; irritability, depression, anxiety, or emotional lability; subjective concentration, memory, or intellectual difficulties without neuropsychological evidence of marked impairment (Barlow, 2016).

There is no longer a category for PCS in the *DSM-5* (APA, 2013). Instead, there is a new diagnostic category known as neurocognitive disorders, and within this category is a diagnosis of major or mild neurocognitive disorder due to TBI (Friedland, 2015). There is no longer reference to PCS but, rather, to different severities of TBI, which

include mild, moderate, and severe TBI (Friedland, 2015).

One in seven children will have post-concussion syndrome for 3 months or longer after a mild TBI (Barlow, 2016). Although these symptoms usually resolve, there have been reports of persistence of these symptoms over time, which may be influenced by subjective anxiety levels. Ambiguity arises when individuals who sustain mild TBIs report persistent somatic, cognitive, emotional, motor, or sensory disturbances in the absence of neurological markers (Barlow, 2016). Because these symptoms are subjective and common to other conditions, there is controversy about whether PCS should be identified as a diagnostic syndrome (Lagarde et al., 2014).

Substantial controversy exists surrounding PCS because of a lack of consensus regarding diagnostic criteria; symptoms that are common in normal populations; the contribution of sociological, psychological, and medicolegal factors to outcomes; and, until recently, a failure to identify any abnormal pathophysiology (Barlow, 2016). Studies show that post-concussive-like symptoms are generally not related to TBI at the milder end of the spectrum, particularly as time goes by, but instead are associated with accompanying acute posttraumatic stress, chronic pain, depression, or anxiety disorders (Friedland, 2015). Lagarde et al. (2014) conducted a prospective study of the 3-month PCS and posttraumatic stress disorder (PTSD) symptoms of mild head injury and non-head injury patients, comparing the prevalence and risk factor for PCS and PTSD. Included in the study were 534 patients with head injury and 827 controls with other non-head injuries. Three months following trauma, 21.2 % of head injured and 16.3% of non-head injured patients fulfilled the *DSM-IV-TR* diagnosis of PCS, and 8.8% of head injured patients fulfilled the diagnostic criteria for PTSD compared with 2.2% of control

patients. In multivariate analysis, mild TBI was a predictor of PTSD, but not of PCS.

Garden and Sullivan (2010) examined the relationship between self-reported PCS symptomatology, demographic characteristics, and depression in a healthy sample. The results were consistent with past research suggesting that self-reported PCS symptoms are not specific to mild TBI, but may be due to or influenced by other factors, such as depression. A comprehensive assessment is necessary to evaluate a child with PCS, paying particular attention to the risk factors for poor recovery (Barlow, 2016). The TBI is the initial insult, but many preexisting or environmental factors influence outcome (Barlow, 2016).

**Second impact syndrome.** Second impact syndrome (SIS) is a controversial term first described by Schneider (1973) and Saunders and Harbaugh (1984). The syndrome occurs when the individual sustains an initial head injury and then suffers a second head injury before resolution from the prior head injury (Bey & Ostick, 2009). There is little epidemiological data about SIS. Most of the information comes from case reports. The overall incidence of SIS is unknown (Bey & Ostick, 2009). Typically, the individual suffers symptoms from the initial head injury, which may include headache; labyrinthine dysfunction; visual, motor, or sensory changes; or mental difficulty, especially cognitive and memory problems. If the individual sustains a second head injury within several weeks, diffuse cerebral swelling, brain herniation, and death can occur (Cantu & Gean, 2010).

The pathophysiology of SIS is thought to be derived from a loss of autonomic regulation of blood vessel diameter, which leads to an increase of blood flow, resulting in diminished cerebral perfusion, increased cranial pressure, and increased risk of brain

herniation (Cantu & Gean, 2010). Children and young adults appear to be at greater risk for SIS and other, less morbid secondary complications of concussion (Bey & Ostick, 2009).

### **Cognitive Consequences**

Cognitive consequences of TBI range from global reductions in intellectual ability, executive function, speed of response, language processing, and visual-perceptual skills, as well as headaches and alteration of mental status (Barlow, 2016; Taylor et al., 2003). In addition, memory disorders are a common and persistent psychological consequence of TBI. These deficits may adversely impact a child's capacity to interact with his or her environment, resulting in increased gaps between the abilities of injured children and those of their peers (Anderson et al., 2001). Preexisting learning difficulties and attention problems can be "unmasked" by a mild TBI (Barlow, 2016). This may be because children with lower cognitive abilities have a reduced capacity to cope with neurological insult. For some children injured at young ages, the full effects of the injury may not be evident until later, when they are expected to demonstrate increased competence in executive functions and sophisticated reasoning skills (Barlow, 2016). The organizational and executive functions required at this level may not develop if the relevant areas of the brain have been damaged and are not developing normally (Glang et al., 2004).

The relative vulnerability of the young brain to the impact of TBI and its associated behavioral consequences (i.e., reduced skill and knowledge acquisition) is a relatively new concept (Anderson & Yeates, 2007). It has been argued that the developing brain may be particularly vulnerable to severe cerebral trauma, leading to



poor outcomes in a range of functional areas, including behavior difficulties, learning problems, attentional deficits, and impulsiveness (Anderson et al., 2001). The effects of TBI in a child are particularly profound because the injury occurs to a developing brain. An injury during a period of critical brain maturation (e.g., myelination, dendritic arborization, synaptic refinement) is more likely to alter and impair the outcome (Barlow, 2016). The child's course of recovery is superimposed on normal developmental processes and, thus, has an impact not only on previously learned skills, but also on the development of future skills (Glang et al., 2004). Consequently, some students injured early may do relatively well until they reach middle and high school, when they are expected to demonstrate increasing competence and independence (Glang et al., 2004). Organizational and other executive functions required at this level may not develop if the relevant areas of the brain have been damaged and are not developing normally (Glang et al., 2004). Whether neuropsychological impairment can persist in pediatric mild TBI is debated. Satz and colleagues (1997) provided a comprehensive review of research on mild head injury in children and adolescents from 1970 to 1995, examining cognitive, academic, and psychosocial outcomes in children who sustained mild TBIs. The findings did not support mild head injury being a "silent epidemic" (Satz et al., 1997).

### **Psychosocial Outcomes**

The majority of outcome studies of pediatric TBI have focused largely on cognitive impairment or behavioral dysfunction in the months following injury (Luis & Mittenberg, 2002). In contrast to studies of cognitive and behavior sequelae, studies of emotional and psychiatric manifestations after pediatric TBI have received less attention, and results have been far less conclusive and somewhat conflicting (Ellis et al., 2015;

Luis & Mittenberg, 2002).

A range of psychosocial problems can be seen following TBI in children, including anxiety, depression, personality change, PTSD, ADHD, and substance abuse (Barlow, 2016). Novel psychiatric disorders are seen more frequently as the severity of the injury increases. Children with severe TBI are more likely to have preinjury social factors, neurocognitive deficits, and frontal white matter lesions (Barlow, 2016; Max et al., 2011). As is the case with cognitive impairments, a different symptom pattern may emerge based on which hemisphere is more affected by the child's brain injury (Hale et al., 2011). Specifically, left hemisphere damage may result in exaggerated reactions to stressors, heightened anxiety, and bouts of tearfulness. Conversely, right hemisphere damage may lead to risk-taking, poor awareness of personal limitations, and overall poorer psychosocial functioning (Hale et al., 2011). Depending on the type and severity of TBI, different frontal-cortical, temporal, and/or hemispheric loss or reduction of function could result in different forms of psychopathology (Hale et al., 2011).

Internalizing problems such as anxiety and depression can also be thought of as a result of both primary damage to the brain and psychological reactions to the injury, such as the emotional response to suddenly being impaired and being uncertain about the prospects of recovering and leading a normal life (E. Clark, 2006). Surprisingly, individuals with less severe injuries report higher levels of depression (Steel, Dunlavy, Stillman, & Pape, 2011). Behavior and emotional symptoms experienced after TBI may include depression, anxiety, impaired social communication, and posttraumatic stress (Dam-O'Connor & Gordon, 2013). In addition, social isolation, impulsivity, agitation/aggression, and apathy have been reported. These subjective, poorly defined

symptoms overlap with neuropsychiatric and medical conditions, so their etiology is controversial and often considered to be psychiatrically based (Jantz et al., 2015).

Psychosocial disorders may not be detected in young children immediately following TBI, but may become apparent years after the injury when the child reaches a stage of development with different social and emotional demands, when social interaction requires more complex solutions and sophisticated communication skills (Glang et al., 2008; Ross et al., 2011). One study found that children who developed novel definite anxiety disorders were significantly younger at the time of injury, compared to those who did not. There is now robust evidence that younger age at the time of TBI in children is an important risk factor for adverse immediate and long-term outcomes (Max et al., 2011).

The emotional symptoms of concussion (frustration, depression, irritability, and restlessness) are not commonly reported on medical presentation, but tend to develop in patients during follow-up, and are among the longest lasting symptoms (Eisenberg, Meehan, & Mannix, 2014). This suggests that brain injuries in children, even milder forms, increase the risk for subsequent internalizing psychiatric symptomatology (i.e., anxiety and depression; Luis & Mittenberg, 2002). Often, little can be done to modify primary damage related to TBI; however, the secondary effects, including emotional disturbance, may be potentially minimized (Luis & Mittenberg, 2002). Post-injury stress levels and the severity of TBI are influential factors in psychiatric outcomes following TBI. Although the physical symptoms of concussion present and resolve early after injury, emotional symptoms develop later and cognitive symptoms impair many patients both immediately and long into their recovery periods (Max et al., 2011).

The research on the psychosocial outcomes post-TBI sometimes conflicts. After investigating enduring subjective complaints following TBI through a meta-analytic review, Panayiotou, Jackson, and Crowe (2009) suggested that a poor relation exists between the development of psychosocial symptoms and students with mild TBI. Conversely, Kosaka (2006) reports that depression has been found as the most frequent psychiatric diagnosis at 1-year post-injury.

Clinical reports and case studies suggest that TBI can have significant social consequences, with social dysfunction, social isolation, and social rejection reported to be the most debilitating problems for children (E. Clark, 2006; Rosema et al., 2012). This is not surprising, as brain injury can reduce opportunities for a child to interact with peers. Other related problems include reduced motor skills, often affecting the child's participation in sports, and decreased confidence and motivation to initiate social contacts (E. Clark, 2006). Evidence suggests that social skills are not correlated with a specific brain region, but are mediated by an integrated neural network. Many components of this network are susceptible to disruption in the context of TBI, resulting in social dysfunction (Rosema et al., 2012).

Studies of social adjustment reported poor self-esteem, loneliness, and maladjustment in the context of reduced emotional control and aggressive antisocial behaviors. These social difficulties are known to be associated with persisting psychological problems, reduced social participation, and reduced quality of life (Roesma et al., 2012). Children and adolescents with TBI of various severities are at risk for long-term comorbidities such as poor school performance, family dysfunction and substance abuse (Ellis et al., 2015).

Although TBI can have detrimental effects on psychosocial functioning in children, understanding of socioemotional functioning in children is limited (Ross et al., 2011). Adaptive dysfunction and behavior disturbance, though relatively unexplored in the literature, is the most common complaint identified by children (Anderson et al., 2006). In the behavior realm, many students with TBI, particularly those with prefrontal lobe injuries, may appear angry, aggressive, disinhibited, oppositional, and socially inappropriate, which may be direct consequences of the injury or frustration associated with academic or social failure (Glang et al., 2004). It is often these disturbances that cause the most distress. These difficulties have been shown to increase over time, potentially resulting in poor long-term adjustment (Anderson et al., 2006).

Changes in psychosocial functioning may be the most prominent changes after TBI, but the least recognizable in the classroom (Hale et al., 2011). Children with TBI are generally less likely to exhibit persisting impairments across functional domains with the exception of behavior. In this area of function, children with mild injuries demonstrate both mild and clinically significant behavior problems. Hooper et al. (2004) studied neurological, neurocognitive, behavioral, and school problems for 409 children and adolescents who sustained TBIs and were evaluated in hospital emergency departments. Follow-ups were completed at 1, 4, and 10 months post-injury. By the 10-month time point, all of the students had returned to school full-time, but 6.9% reported to continue experiencing new learning and/or behavior problems, suggesting that these types of problems may be critical to monitor following a mild TBI (Anderson et al., 2006; Hooper et al., 2004).

### **Educational Impact**

Many children return to school full-time within the first month after a TBI that required medical attention (Deidrick & Farmer, 2005); however, the recovery process can take months and, thus, many return to school while still in the recovery stages (Bowen, 2008). It often becomes the responsibility of the educational system to facilitate ongoing recovery and provide needed services to help the children progress in their academic and social functioning (Bowen, 2008). In addition, school reentry may be more difficult if the student continues to experience lingering problems (Deidrick & Farmer, 2005). Without targeted support, children who sustain TBIs are at greater risk for grade failure and retention. For children who return to the classroom full-time after TBI, teachers and parents report long-lasting academic and psychosocial concerns related to school functioning (Deidrick & Farmer, 2005).

The academic and social success of the student after TBI will depend on many variables, such as the severity and anatomical site of the injury, age at the time of injury, academic achievement prior to injury, and familial issues (e.g., family stability, family coping style; Taylor et al., 2003). Pre-injury weakness in cognitive or academic skills may also predispose children to post-injury special education placement (Corwin et al., 2014), and have an impact on the academic and social success of the student (Taylor et al., 2003). Although there is considerable variability in outcomes following TBI, there are also general features of TBI common to children who sustain brain injury with structural damage. These are related to the vulnerable areas of the brain often affected during a closed head injury, including damage to the frontal lobes and the anterior and medial temporal lobes. Children with frontal lobe damage have difficulty with executive function, including attention, self-regulation, goal-setting, and initiating and inhibiting

behavior, as well as problems with organization and planning (Bowen, 2008). Recalling and retaining information is one of the most common deficits with TBI (Bowen, 2008). Academically, deficits can be found in all domains, including reading, mathematics, and writing (Barlow, 2016). Psychosocial and behavioral difficulties reported in the classroom include poor frustration tolerance, emotional lability, anxiety, depression, isolation, and poor social competence (Hale et al., 2011).

There is conflicting information on the outcome of TBI on academic performance. Glang et al. (2004) reported that TBI impacts students' abilities to perform in cognitive, behavioral, and social domains in unpredictable and often confusing ways. Cognitive effects include problems in general intellectual function, memory and attention, and visual-motor abilities, as well as significant impairment in executive function. For students with moderate to severe injuries, there is often a significant decline in academic performance. Conversely, H. Klonoff, C. Clark, and P. S. Klonoff (1993) studied transitional outcomes for young adults who had experienced mild to moderate brain injuries as children and found that although students experienced a number of serious social adjustment challenges, neither education nor employment were affected adversely.

Everyday school-based outcomes are generally poor after pediatric TBI (Arnett et al., 2013). Standardized tests provide a measure of relative performance so parents and teachers know how the students rank among peers, as well as students' relative strengths and weaknesses (E. Clark, 2006). Nevertheless, the existing literature is mixed regarding the utility of general cognitive, neuropsychological, and achievement testing to predict classroom outcomes above and beyond the effects of injury severity (Arnett et al., 2013). Students with TBI challenge educators with their non-linear learning and behavior

profiles that may change over time in response to developmental changes and increased academic and behavioral changes (Glang et al., 2010). The performance of student with TBI may fluctuate widely from week to week or day to day across settings or various types of tasks (Glang et al., 2004).

Understanding the academic difficulties experienced by student after TBI is important for developing appropriate interventions and maximizing long-term adjustment. To that end, it is necessary to investigate the developmental course of growth and recovery (Ewing-Cobbs et al., 2004). Younger students, especially those 12 and younger, have been shown to have a prolonged recovery compared to older adolescents; however, they were not found to have worse functioning on school-related outcomes, possibly because of the less rigorous academic demands of children this age (Corwin et al., 2014).

It is important to gather data about the child's pre- and post-injury cognitive, academic, developmental, social, and behavioral functioning, as well as preexisting problems with learning or behavior that may exaggerate TBI's effects (Deidrick & Farmer, 2005). For example, TBI often interferes with new learning; it is helpful if educators understand what specific skills the child had acquired or was in the process of learning before sustaining a TBI (Hale et al., 2011). Long-term follow-up studies of children conducted during the K-12 school years suggest that problems associated with TBI tend to persist or worsen as children progress through school (Glang et al., 2008). Given that cognitive weaknesses interfere with the learning of new information, some children with TBI may have difficulty keeping up with same age peers and can show a corresponding decline in achievement test scores over time (Deidrick & Farmer, 2005).



Additional knowledge about the interrelations between academic skills and executive function will enhance the development of intervention strategies (Corwin et al., 2014). The interventions selected for these students must be grounded in a firm understanding of the specific effects of the brain injury on each student's current level of functioning and his or her approach to learning (Glang et al., 2004). Emphasis should be placed on the evaluation of cognitive sub-skills necessary for development of academic competence, such as fluency and rate of word retrieval, phonological awareness, phonological and visual working memory, and sequencing skills. Additional variables include self-management skills, metacognition, focused attention, and planning, as well as measures of discourse such as summation, inferencing, and gist recall (Ewing-Cobbs et al., 2004). Relationships between academic competence and measures of skills theoretically related to academic performance, such as deficit in executive function, discourse, and self-management, should be assessed to characterize assets and liabilities that may influence academic skills development (Ewing-Cobbs et al., 2004).

### **Educators**

In a recent survey of educators working with students with TBI, an overwhelming 92% reported having no training in the academic ramifications of TBI (Glang et al., 2010). Few educators have an understanding of the complex and unique issues faced by students with TBI. Most do not receive pre-service training on the effects of TBI on school performance (Glang et al., 2004). The 2001 National Association of State Directors of Special Education (NASDSE) Survey revealed that none of the responding states had a TBI certification program. Ten states reported the availability of pre-service courses in TBI, and only 8% of graduate programs in special education include courses in

TBI (Glang et al., 2004). Surveys of teacher knowledge of brain injury and misconceptions about recovery will highlight important areas for TBI education (Deidrick & Farmer, 2005). To meet the academic and behavioral needs of the student with TBI, educators need training in methods that have been validated with students with TBI (Glang et al., 2010). Given the complex needs of students with TBI coupled with the educators' lack of knowledge and training in TBI, educational personnel serving these students would benefit from systematic support that includes information about specific aspects of each student's disability and expert technical assistance when needed (Glang et al., 2004). Additionally, a neuropsychologist with an understanding of school consultation would be invaluable to the team (Ernst, Pelletier, & Simpson, 2008).

As educators increasingly recognize their need for additional training to address the challenges of students with TBI, the literature suggests that training and support for educators must include training in evidence-based interventions, supervised practice in both the training site and classroom, and continued mentoring, feedback, and consultation in trainees' classrooms. Two models currently in use, the TBI Consulting Team and BrainStars, incorporate features of effective professional development; however, both models lack evidence of impact on student outcome and funding for both models is limited to model implementation rather than research on efficacy (Glang et al., 2010).

There is a growing concern among educational professionals, advocates, and family members that the educational needs of students are not being met currently. A primary factor underlying this concern is what appears to be the significant under-identification of children with TBI for special education services in our nation's schools (Taylor et al., 2003). Students with TBI continue to be underserved and under-identified

for educational supports. School systems erroneously consider TBI a “low incidence disability” (Glang et al., 2010).

Shortcomings in service provisions are understandable, given the limited resources and lack of awareness of the unique needs of children with TBI. Students post-TBI who are identified for special education services and possibly difficulty with executive functioning (EF) in the classroom setting are interpreted by school personnel as indications of poor self-regulation, rather than cognitive issues that might warrant targeted interventions (Arnett et al., 2013). Amelioration of their educational problems is not likely to occur without more intensive forms of interventions and additional training of school staff in assessment and intervention procedures. Efforts to improve services are justified by the effectiveness of school-based interventions designed for children with TBI (Taylor et al., 2003).

An accurate count of students with special education needs resulting from TBI is currently unavailable. The incomplete statistics that are available raise questions about the current practices for special education identification for students with TBI and the appropriateness of educational programs being provided to these students (Glang et al., 2004).

### **Self-Report of Post-TBI Functioning**

**Educational functioning.** Students have identified two major barriers to resuming school participation after TBI (Mealings et al., 2012). First, many staff reported a general lack of understanding of TBI and limited awareness of students’ specific needs, making being at school more difficult. Second, students have been shown to not receive the help they request, including a lack of implementation of the special

accommodations agreed upon in planning meetings (Mealings et al., 2012). All too often, the differences in philosophy and system structure between the medical and educational environments contribute to inadequate communication and poorly coordinated services for these children returning to school (Harvey, 2002). This can be avoided through ongoing communication between the medical and school staff early in the recovery process. Additionally, school personnel should reach out to the family members to solicit input concerning their needs and wishes for their child, in addition to their attitude toward school and the child's injury (Harvey, 2002).

In addition to barriers to returning to school, students also reported challenges in schoolwork following TBI (Mealings et al., 2012). One of the most frequently reported problems was the need to exert more effort to get the same results as prior to a TBI. Other commonly reported cognitive changes included memory impairments, difficulty paying attention and concentrating, and cognitive fatigue (Mealings et al., 2012), as well as frustration adjusting to and balancing the multiple demands of school (Ruoff, 2008).

A subgroup of children who sustain TBI may experience less intimacy in their friendships and have more problems with conflict management. These difficulties are likely the consequence of core deficits in cognitive functioning (Mealings et al., 2012). Specifically, executive functioning difficulties may make it more difficult for children to regulate their emotional responses, adjust their interactions (social pragmatics), and generate a number of good potential solutions to common social conflicts (Glang et al., 2010). Students have also reported feelings of being misunderstood and being treated differently by others after TBI. These feelings were closely related students' descriptions of difficulty finding and fitting in with friends (Mealings et al., 2012). Students reported

a sense of disconnection from their peers and a sense of having lost their old selves and not liking the new people they have become (Ruoff, 2008). Students described feelings of loneliness, isolation, and depression, as well as loss of self-esteem and confidence (Ruoff, 2008).

Finally, students described forgetting what was said in class, needing to review material more often to remember it, and getting into trouble, including by receiving detention due to forgetting. Concentration and processing speed difficulties also affected student participation, causing students to “listen harder” and pay more attention in class to become overloaded by information, as well as having difficulty understanding complex information (Mealings et al., 2012). Students report embarrassment about forgetting important things such as assignments, schedules, dates, and names of faculty and students (Ruoff, 2008). Difficulties with organization were described as procrastinating and having trouble managing time. In relation to courses taken, it was reported that students had to change their courses and educational or vocational goals after their injuries (Ruoff, 2008). Other impacts have been described by students, including getting nervous before tests, difficulty giving oral presentations, and being too tired at the end of the day to complete homework (Mealings et al., 2012).

A common theme within the analysis of student experiences is the contribution of individual student factors such as personality, feelings, emotions, personal goals, and adjustment on their perceptions and responses to being at school. Despite recognizing the multiple impacts on their studies, many students noted a reluctance to identify themselves as impaired by disclosing their TBIs when returning to school (Mealings et al., 2012).

**Psychosocial functioning.** Anxiety, frustration, failure, and helplessness have

been reported by individuals with TBI as they become aware of the functional consequences of their deficits (Dams-O'Connor & Gordon, 2013). The feelings of loss, sadness, and difficulty adjusting to their changed situations has been well described by students. Reduced self-esteem has been reported (Mealings et al., 2012). Generalized changes to mood, including mood swings or being upset more easily, were reported, whereas other students described specific changes such as depression, difficulty managing anger, anxiety, and reduced motivation. These changes can influence motivation for treatment, participation in the community, and maintenance of social support networks (Dams-O'Connor & Gordon, 2013; Massagli et al., 2004).

There are relatively few studies published in which students have been invited to share their experiences and perspectives following TBI (Mealings et al., 2012). Research into the lives of children with TBI often neglects to incorporate children as participants, preferring to obtain the opinions of the adult caregivers; there has been an attempt to move away from this position by those working in children's research (Boylan, Linden, & Alderdice, 2009). Levack et al. (2014) reported a key finding from their transcription of audio recordings from focus group meetings was that loss and reconstruction of self-identity and personhood were recurring themes in the narratives of people talking about their experiences following TBI. Kennedy, Krause, and Turkstra (2008) developed the College Survey for Students with Brain Injury (CSS-BI), which was distributed electronically. Of the 35 respondents with TBI, nearly three quarters of the sample reported that anger and depression were effects of their injuries. Broader effects of mood changes and difficulty with relationships were reported by about one half of the respondents. From the recent research of Rosema et al. (2012), a 23-year review of social

function in children and adolescents revealed that the majority of the studies utilized indirect assessment methods (e.g., parent- and teacher-rated questionnaires to describe children's social skills). Obtaining parent perspectives alone may result in a lack of information regarding internalizing symptoms that are not evident to parents. In addition, reliance upon reports from the same parent for both predictor and outcome measure may inflate correlations observed within data sets due to shared method variance (Trenchard et al., 2013).

### **Interventions**

**Educational interventions.** Students with TBI have been eligible to receive special education services under IDEA since 1991, under the category of Traumatic Brain Injury (IDEA 2005). Educationally, TBI is defined as an acquired injury to the brain caused by an external force, resulting in total or partial functional disability or psychosocial impairments, or both, that adversely affects a child's educational performance. The term applies to open or closed head injuries resulting impairments in one or more areas, such as cognition; language; memory; attention reasoning; abstract thinking; judgment; problem solving; sensory, perceptual, and motor abilities; psychosocial behavior; physical functions; information processing; and speech. The term does not apply to injuries that are congenital or degenerative, or brain induced by birth trauma (34 C.F.R. 300.7 © [12]).

To receive services, the brain injury must adversely affect the student's educational performance and he or she must require specialized instruction (Bowen, 2008). Special education programs are frequently selected as an intervention of choice for students with TBI, as they can provide a lower adult-to-pupil ratio, as well as offer

individually designed curriculum, specialized instruction, and necessary therapies. Students with TBI who attend mainstream classes may receive accommodations or related services under the Rehabilitation Act of 1973, Section 504 (Popoli, Burns, Meehan, & Reisner, 2013). Section 504 covers all students who have physical or mental impairments that substantially limit one or more major life activities, including learning (Bowen, 2008).

The educational outcomes of students with TBI are not been well described. Limitations of current research are lack of longitudinal achievement scores from a comparison group of children without TBI, lack of objective measures of educational performance, and lack of pre-injury cognitive and academic functioning data (Arnett et al., 2013). Research on precise indices of injury severity, neurobehavioral deficits, educational outcomes, and, most critically, the effectiveness of educational interventions is needed (Taylor et al., 2003).

Supporting students as they return to school, regardless of the time post-injury, is key. Several suggestions have been provided in the literature. First, parents and adolescents should talk to the school before adolescents return to school (Barlow, 2016). Second, because of the changing nature of abilities and demands, students with TBI require a more comprehensive tracking system than is in place for students with other disabilities (Glang et al., 2004). Researchers and school staff document that students with TBI display behavior characteristics that are significantly different from other students. The selection of interventions for these students must be grounded in a firm understanding of the specific effects of the brain damage on each student's current level of functioning and approach to learning (Glang et al., 2004). Third, when possible,



exemptions should be made so that the student does not have to catch up on all assignments or work missed and, instead, priority projects or key areas should be identified. Exemptions from examinations and tests should be made during the first phase of return to school, and accommodations such as a quiet environment for taking test should be arranged. A gradual return to full participation is recommended (Barlow, 2016).

The American Medical Society of Sports Medicine recommends academic accommodations, such as a reduced workload, extended time taking tests, days off, or a shortened work day after sustaining a concussion; however, at this time there is no standardized guideline on this issue. Therefore, school policies regarding academic accommodations for concussed individuals vary broadly (Popoli et al., 2013). An individualized education plan (IEP) should be developed. The goal to support the recovering student in keeping up with academic demands in a way that does not overstress the cognitive functions and result in worsening symptoms (McGrath, 2010).

For some students with mild TBI, only minor accommodations may be necessary to support them, such as changing seating arrangements, removing distractions, providing variable instructional delivery, or offering frequent breaks. Others with a protracted recovery may need homebound instruction to help condense assignments and reduce school-related stress (Popoli et al., 2013).

Classroom structure should also include a predictable and consistent routine. Consideration should be given to the length of the school day that students can tolerate, as well as students' nutritional needs, fatigue level, and need for frequent breaks (Bowen, 2008). Reasonable accommodations for students in recovery include excused absence

from class depending on the intensity of the symptoms, rest periods throughout the school day in a supervised quiet location as needed, and being excused from nonessential schoolwork (McGrath, 2010).

Additional time for essential assignments and projects, pre-printed class notes (which may be important supplements to taking notes in class), and extended time for test taking are important considerations. Once students have attained a level of recovery that allows for return to learning, they may only take tests at a rate of one per day; those tests should be untimed and broken up over multiple days if needed (McGrath, 2010). There will be some students who are able to ramp up their cognitive activities quickly over a few days, which is often seen with the first concussion (Master et al., 2012). In contrast, there are many who require a slow, controlled ramp-up in cognitive activities to prevent recurrence of concussion symptomology. An essential component of this controlled ramp-up involves the concept of a trial cognitive activity before returning to school (e.g., attempting homework at home before attempting schoolwork at school; Master et al., 2012). Some students will only tolerate 20 minutes of cognitive activity initially, whereas others may tolerate longer periods without symptoms. Upon return to school, it is important for the school staff to be aware of the accommodation necessary to support each student (Bowen, 2008).

Empirically supported teaching strategies that are effective with students with different types of learning difficulties also may prove useful for students with brain injury (Bowen, 2008). Schools may have a tendency to focus on academic objectives and interventions for a child, but as Ewing-Cobbs and colleagues (2004) argue, interventions should target both academic-specific deficit areas and the cognitive deficits that underlie

them (Hale et al., 2011). It has been suggested that targeted interventions should focus on deficits of attention, orientation, perception, memory, planning and organization, and sensory-motor functions (Lajiness-O'Neill et al., 2010).

Educators should focus on best practice and methods shown to be useful for students with special needs in general. Two general strategies with several populations of children include direct instruction and cognitive strategy intervention (e.g., self-regulated strategy intervention, graphic organizers; Lajiness-O'Neill et al., 2010). The direct instruction model is based on principles of applied behavior analysis (Bowen, 2008). It encompasses two interrelated components, carefully designed curriculum materials and enhanced delivery, with the goal of ensuring high rates of success. Components of direct instruction that have errorless learning as the goal include task analysis, modeling, prevention of guessing, gradual fading of prompts, pacing, and reinforcement to maintain student engagement and ensure learning (Lajiness-O'Neill et al., 2010). Errorless learning is based on a model of behavioral rehabilitation that involves discrimination training with early prompting and support that is systematically faded to ensure successful responding (Bowen, 2008). Students with memory problems benefit from this teaching approach (Lajiness-O'Neill et al., 2010).

**Psychosocial interventions.** Chronic behavior problems are some of the most devastating sequelae of TBI. They not only affect the student's ability to learn but also interfere with positive family interactions and meaningful social relationships (E. Clark, 2006). Compared with studies of children with developmental delays, empirical studies of children with TBI are few. Psychosocial variables are seldom assessed following TBI unless there is a question of abuse or neglect (Luis & Mittenberg, 2002). Psychosocial

variables such as depression, anger, mood changes, and trouble with relationships have been related to academic challenges (Mealings et al., 2012). Although each student who has incurred TBI displays a unique constellation of behaviors, commonalities exist. A student who appears lazy and unmotivated may also have trouble inhibiting irritating or explosive behaviors. Such students are unable to change behaviors in response to contingencies (Harvey, 2002).

For the student, it may help to normalize the experience of recovery from TBI, preventing the additional stress that comes from worrying that symptoms are unusual or excessive (Eisenberg et al., 2014). Post-injury stress is a clear moderator of mood and anxiety disorders. Treatment interventions, such as improving coping skills, may be crucial in preventing or mitigating the potential emotional consequences of TBI (Luis & Mittenberg, 2002). Evidenced-based interventions should be developed that are appropriate for the students presenting difficulty and fit within the culture of the classroom, and progress should be monitored continually (Hale et al., 2011).

Parents and children have identified difficulties with peer relations as a significant feature after TBI (Heary, Hogan, & Smyth, 2003). Interactions with peers at school help foster the development of social skills and social networks, which may be critical in helping children with TBI (Deidrick & Farmer, 2005; Heary et al., 2003). The student will require support at school for social development as well as academic success (Deidrick & Farmer, 2005). Interventions that are often used to improve social relationships of children with TBI include cognitive behavior methods, social skills training, school-based friendship building, and networking (E. Clark, 2006). Many children and parents have reported that the presence of supportive friendships is a crucial

factor in the child's post-TBI adjustment (Heary et al., 2003). Teachers have identified benefits of placing children with friends upon their return to school (Heary et al., 2003).

School psychologists are in a prime position to identify, advocate, and serve students with TBI. They are best suited to work with these children at all levels (individual, group, and systems) using appropriate short-term, school-based, TBI-related grief counseling and services (Jantz et al., 2015). These services should be designed and implemented to target children's adaptation to grief, generalized mood changes, and reconstruction of the self to provide the students with the feeling of success and help them to identify educational goals to increase school success both academically and behaviorally (Jantz et al., 2015; Mealings et al., 2012).

Students experiencing behavior and personality changes after TBI may require assessment and observation of environmental factors in the classroom (Hale et al., 2011). This includes a focus on "moderator" variables: social, environmental, and motivational factors that influence the child's ability to cope and adjust to the presenting disorder (Harvey, 2002). Successful reintegration for students with TBI requires careful identification of each child's unique needs and abilities, and the selection of classroom interventions designed to meet those needs (Bowen, 2008). As part of this process, it is important to investigate the home-school relationship, classroom structure and curriculum, and teacher instructional methods and behavior management skills, as well as tolerance for behavior (Hale et al., 2011). It is important that the teacher understands the brain-behavior relationship in relation to TBI so the academic or psychosocial problems are not viewed as noncompliance (Hale et al., 2011).

Structuring the school environment is a way to manage antecedents or

consequences contributing to many problem behaviors and prevent the behaviors from occurring. Research has shown that behavior interventions that focus on antecedents hold the most promise for managing behaviors. Classrooms with carefully planned routines, clear performance expectations, and the use of positive reinforcement only is the preferred strategy when working with the student with TBI (E. Clark, 2006; Hale et al., 2011).

Self-management training may also be beneficial. Self-management involves teaching the student to evaluate and monitor his or her own behavior and performance. Forms of self-management include the routine recording of behavior, use of a checklist or open-ended questions to guide the student through an assignment, an assignment rubric, and the use of emotion logs to allow the student to monitor his or her emotions (Bowen, 2008).

Critical review of the literature describing the psychosocial effect of pediatric TBI often indicates inconsistent results. This arises due to the methodological limitations of the research and the heterogeneous populations studied. There has been little attention paid to the emotional and psychiatric manifestations of TBI (Ellis et al., 2015). Future research looking directly at friendship quality and social outcomes following TBI is needed. Research designs with sound methodologies that investigate the contributions of both biological and environmental factors to social outcomes following TBI are minimal (Rosema et al., 2012; Ross et al., 2011). Longitudinal research is needed to determine whether cognitive and affective markers of risk can be demonstrated to predict a poorer social trajectory. The incorporation of observational measures in the naturalistic setting and the gathering of multi-informant perspectives, such as teachers, is necessary before

conclusions can be made with confidence regarding social functioning in children with TBI (Ross et al., 2011). Future studies using standardized psychological assessment tools that provide comprehensive assessment of pre- and post-injury mental health, psychosocial stress, family functioning, and SES are needed to establish the future risk of developing psychiatric disorders after TBI (Trenchard et al., 2013).

### **Conclusion**

Pediatric TBI is a serious issue that impacts many children and adolescents each year (Trenchard et al., 2013). The disorder is considered a “silent epidemic” because of the variability and hidden nature of many of the symptoms (Langlois et al., 2006). Students with TBI may suffer from a constellation of physical, cognitive, learning, and emotional symptoms (Scherwath et al., 2011). Few studies have examined pre-existing conditions in these children (Corwin et al., 2014). The limited literature available often indicates inconsistent results on this topic (Trenchard et al., 2013). The psychosocial outcomes after TBI in children and adolescents is an area that needs further investigation (Rosema et al., 2012). Research incorporating a multi-informant perspective should be gathered before conclusions can be made regarding the psychosocial functioning in children with TBI (Ross et al., 2011). Most importantly and virtually missing from research is the student’s perspective regarding the impact TBI has had on his or her academic, psychosocial, adaptive, and behavioral functioning. Seeking the opinion from students returning to school is a relatively new addition to the field of investigating return to school post-TBI (Mealings et al., 2012). Studies that explore the student’s perspectives on TBI have generally been limited to health-related quality of life assessments (e.g., Moran et al., 2011). Currently, gross measures include questions such

as the number of subjects a student completes, what accommodations are used, and the amount of tutoring time needed (Mealings et al., 2012). These measures do not address issues related to the student's sense of adjusting to his or her changed situation nor do they invite the student to share his or her experiences and perspectives following TBI (Mealings et al., 2012).

The present study aimed to critically evaluate the cognitive, academic, and psychosocial functions of high school students post-TBI. Particular attention was paid to the subjective psychosocial experience reported by each student.



### **Chapter 3: Method**

#### **Overview**

This study measured psychosocial and academic functioning as it relates to TBI, age at the time of injury, time since injury, and risk factors. Biological and environmental factors were explored. Academic performance, attendance, discipline referrals, and the level of educational interventions utilized were investigated. Approval was obtained through the Philadelphia College of Osteopathic Medicine's (PCOM) institutional review board (IRB) prior to the initiation of any study-related procedures. This study was a correlational pilot study using medical history and education records including demographic information, GPA, local and state assessments, attendance, behavior records, and educational classification. Previous psychoeducational evaluations were also reviewed to investigate the relationship between pre- and post-functioning of the student as it relates to the psychosocial and academic functioning after TBI.

#### **Participants**

Twenty high school students participated in the study: 12 males and 8 females with ages ranging from 14 to 18. Participants were recruited from a suburban high school in a predominantly middleclass suburb outside of Philadelphia. To be included in the study, students had a documented TBI between September 1, 2014 and December 1, 2016. Thirty-nine students ages 14 to 18 years met the criteria initially. Potential parent participants were contacted by phone. A script was used during the personal phone call (Appendix A). Student participants were interviewed by the investigator. A script was used during the formal meeting and to gain assent (Appendix B). Nineteen parents or guardians declined participation in the study. For those who consented and assented via

telephone, written consent and assent were obtained to review the students' education records and collect additional academic and psychosocial data ( $N = 20$ ). A packet was sent home including the consent and assent forms, developmental history questionnaires, and the Behavior Assessment System for Children (BASC-3). Upon receipt of the signed consent and assent forms, the education records were reviewed. Seventy-five percent of the student participants had a medical diagnosis and approximately 25% participated in the Free and Reduced Lunch Program. Characteristics of the student participants are presented in Table 1. Descriptions of participants' medical diagnoses, Free and Reduced Lunch participation, and IEPs are found in Table 2.

Table 1

*Demographic Characteristics of 20 Students with TBI*

<b>Student Characteristics</b>	<b><i>n</i></b>	<b>%</b>
<b>Gender</b>		
Male	12	60%
Female	8	40%
<b>Ethnicity</b>		
African American	4	20%
Asian	1	5%

White	15	75%
<b>Age (years)</b>		
14	1	5%
15	5	25%
16	7	35%
17	3	15%
18	4	20%
<b>Time since TBI (months)</b>		
1-12	7	35%
13-24	6	30%
25-36	5	25%
37-48	2	10%
<b>Free Reduced Lunch</b>	5	25%
<b>Number with IEP</b>	13	65%

Table 2

*Description of Participant Medical/Psychiatric Diagnosis, Free and Reduced Lunch Participation, and Individualized Education Plan (IEP)*

<b>PARTICIPANT #</b>	<b>MEDICAL DIAGNOSIS</b>	<b>IEP</b>	<b>FREE REDUCED LUNCH</b>
<b>1</b>	Diabetes	No	No
<b>4</b>	ADHD	Yes	No
<b>7</b>	Depression	Yes	No
<b>16</b>	None	No	No
<b>25</b>	Depression	Yes	No
<b>29</b>	ADHD	No	Yes
<b>31</b>	ADHD	Yes	No
<b>32</b>	Asthma	Yes	No
<b>34</b>	Bipolar	Yes	Yes
<b>36</b>	Depression	Yes	Yes
<b>37</b>	Asthma	Yes	Yes
<b>40</b>	None	No	No
<b>42</b>	None	Yes	No
<b>43</b>	Depression	Yes	Yes
<b>44</b>	Lyme's Disease	Yes	No
<b>50</b>	Asthma	No	No
<b>52</b>	None	No	No
<b>61</b>	None	Yes	No
<b>62</b>	ADHD	Yes	No
<b>64</b>	ODD	No	No

## Procedure

Following the consent and assent procedure described above, each parent or guardian completed the Background and Developmental History Form ( $n = 14$ ). Questions regarding birth; developmental history; family history; medical history; social, educational, and behavioral functioning; and past psychological, neurological, and educational evaluations were included. In addition, questions regarding services received outside of school following and related to participants' TBIs were added (Appendix C).

A record review was conducted, including an examination of medical and educational documents available as part of the school records. Medical documentation of TBI, including the type, location, severity and time since TBI was reviewed, as well as history of hospitalizations and neurological interventions. The education record, including grades, psychoeducational testing (including standardized test scores), special education services (including interventions and services), discipline, attendance, and nurse visits was reviewed. Each student's pre- and post-injury functioning was compared when available.

## Measures

**Demographic, environmental, and biological factors.** Preexisting environmental conditions were coded as a "yes" or "no," including whether the student had an IEP prior to TBI ( $n = 8$ ), whether he or she participated in the Free and Reduced Lunch (FRL) program ( $n = 5$ ), and pre-TBI attendance data ( $n = 14$ ; i.e., the number of days the student attended school). Six student participants were new to the school district and attendance data were unavailable. Preexisting biological conditions were coded "yes" or "no" based on whether the student participant had a medical diagnosis prior to

the TBI. The medical and psychiatric diagnoses identified consisted of major depressive disorder (MDD;  $n = 5$ ), oppositional defiant disorder (ODD;  $n = 1$ ), diabetes ( $n = 1$ ); ADHD ( $n = 4$ ), asthma ( $n = 3$ ), and Lyme disease ( $n = 1$ ). Five of the student participants did not have a medical diagnosis.

**Cognitive functioning.** Pre-TBI cognitive functioning was measured using shelf data obtained from the Wechsler Intelligence Scale for Children, Fourth Edition, (WISC-IV;  $n = 8$ ). Post-TBI cognitive function was measured using the fifth edition of the WISC (WISC-V;  $n = 5$ ) or the Wechsler Adult Intelligence Scale, Fourth Edition, (WAIS-IV;  $n = 3$ ). The Full Scale IQ (FSIQ), Verbal Comprehension Index (VCI), Working Memory Index (WMI), Processing Speed Index (PSI), Vocabulary (VC), Similarities (SI), Block Design (BD), Matrix Reasoning (MR), Digit Span (DS), Coding (CD), and Symbol Search (SS) subtests and Index scores were chosen for analysis, as they are common across the versions of the Wechsler Intelligence scales. The FSIQ, VCI, WMI, and PSI are standard scores with a mean of 100 and a standard deviation of 15. The subtest scores are scaled scores with a mean of 10 and standard deviation of 3. Please see Table 3

**Educational functioning.** Educational functioning was measured using three variables, GPA (0 - 100), attendance and discipline referrals. Post-TBI attendance was considered an indicator of educational functioning. Please see Table 3 for an overview of variables examined pre- and post-injury ( $n = 8$ ).

Table 3

*Variables Examined Pre- and Post-Injury for 8 Students*

Domain	Pre-TBI	Post-TBI
	Full Scale IQ <sup>a</sup>	Full Scale IQ <sup>b</sup>
	Verbal Comprehension Index <sup>a</sup>	Verbal Comprehension Index <sup>b</sup>
	Working Memory Index <sup>a</sup>	Working Memory Index <sup>b</sup>
	Processing Speed Index <sup>a</sup>	Processing Speed Index <sup>b</sup>
	Vocabulary <sup>a</sup>	Vocabulary <sup>b</sup>
	Similarities <sup>a</sup>	Similarities <sup>b</sup>
	Block Design <sup>a</sup>	Block Design <sup>b</sup>
	Matrix Reasoning <sup>a</sup>	Matrix Reasoning <sup>b</sup>
	Digit Span <sup>a</sup>	Digit Span <sup>b</sup>
	Coding <sup>a</sup>	Coding <sup>b</sup>
	Symbol Search <sup>a</sup>	Symbol Search <sup>b</sup>
	GPA	GPA
Education	Attendance	Attendance
	Discipline	Discipline

<sup>a</sup> WISC-IV; <sup>b</sup> WISC V or WAIS-IV

**Psychosocial variables.** In addition to the above information collected through a review of records, three measures of psychosocial functioning were collected post-TBI ( $N = 20$ ) and Parent Report (BASC-3 PRS) were administered ( $N = 20$ ). The Self-Report of Personality (BASC-3 SRP-A) was administered to the student and is designed to evaluate the personalities, affect, and self-perceptions of children and young adults. The BASC-3 SRP-A is intended for use with students ages 12 through 18 or with students 19 through 21 who are still in high school.

The clinical scales measure maladjustment. High scores on these scales represent negative or undesirable characteristics that may cause impaired functioning in home, school, peer relationships, or community contexts (Reynolds & Kamphaus, 2015). The SRP-A clinical scales include measures of anxiety, attention problems, attitude toward school, attitude toward teachers, atypicality, depression, hyperactivity, locus of control, school maladjustment, and sensation seeking. Also included in the clinical scales are measures of perceived inadequacy, social stress, and somatization (Reynolds & Kamphaus, 2015). The adaptive scales measure positive adjustment and, unlike scores on the clinical scales, high scores on the adaptive scales represent positive or desirable characteristics and low scores represent possible problem areas (Reynolds & Kamphaus, 2015). The adaptive scales include measures of interpersonal relations, relations with parents, self-esteem, and self-reliance. For the SRP general norm samples, overall average composite scale score reliability coefficients are generally excellent, largely ranging from the upper .80s to the upper .90s. The composite scale score reliability coefficients are fairly consistent across age levels and for both combined gender and separate gender groups (Reynolds & Kamphaus, 2015). The narrative and scale



classifications for the BASC-3SRP-A are based on *t*-scores obtained using norms. *T*-scores have a mean of 50 and a standard deviation of 10. In the four clinical composite areas, scores of 59 and below are considered average, scores of 60 to 69 are considered at-risk, and scores 70 and above are considered clinically significant. Scores above 40 in the adaptive behavior composite are considered average and scores of 30 to 39 are considered at-risk, meaning a problem has been identified but may not require formal treatment. Scores of 29 and below are clinically significant, meaning there is a high level of maladjustment. In all three measures, individual subtest *t*-scores will be used.

The BASC-3 PRS was administered to the participants' parents. Six BASC-3 PRS scales were returned completed. The scales measured in the parent report include several types of scales. The clinical scales measure maladaptive behavior, for which high scores indicate problematic levels of functioning. Items are unique to a clinical or adaptive scale (Reynolds & Kamphaus, 2015). The clinical scales measure aggression, anxiety, attention problems, atypicality, conduct problems, and depression. Also measured are hyperactivity, somatization, and withdrawal. The adaptive scales measure adaptive behaviors or behavior strengths, whereas low scores indicate possible problem areas. Areas measured include activities of daily living, adaptability, functional communication, leadership, and social skills. Internal consistency reliability coefficients for the BASC-3 PRS composite and subscale scores are good to excellent and are generally consistent between females and males, clinical and non-clinical groups, and different age levels.

The Beck Youth Inventory, Second Edition (BYI-II) was administered to assess psychological and psychosocial functioning. The BYI-II is a five-item self-report scale

that may be used separately or in combination to assess a child's experience of depression, anxiety, anger, disruptive behavior, and self-concepts (J. S. Beck, A. T. Beck, Jolly, & Steer, 2011). The BYI-II is intended for use with children and adolescents between the ages of 7 and 18.

Research demonstrates the value of using self-report measures with children and adolescents. Self-report measures are effective tools to obtain information concerning the psychological status of the child. They are particularly important when evaluating internalizing conditions such as depression, anxiety, anger, and self-esteem (J. S. Beck et al., 2011). They are also useful when evaluating for externalizing symptoms, such as disruptive behaviors, as the self-report may provide information that may be unavailable to the child's guardian or potential evaluator (J. S. Beck et al., 2011).

The BYI-II manual discusses three kinds of reliability that were studied using the normative samples taken from the general population. First, an analysis of internal consistency yielded a Cronbach's alpha coefficient that ranged from .86 to .91 for ages 7 through 10, .86 to .92 for ages 11 through 14, and .91 to .96 for ages 15 through 18 across all five scales (Community-University Partnership for the Study of Children, Youth, and Families, 2011). To examine test-retest reliability, a sub-sample ( $n = 105$ ) of the normative sample was retested with the BYI-II approximately one week after first administration. The test-retest reliabilities were calculated, and yielded correlation coefficients in the ranges of .74 to .90 for ages 7 through 10, .84 to .93 for ages 11 through 14, and .83 to .93 for ages 15 through 18. In general, test-retest reliabilities were the same for both males and females (Community-University Partnership for the Study of Children, Youth, and Families, 2011). Finally, the manual discusses the degree to which

measurement error contribute to an individual's observed score. According to the manual, average standard of measurement coefficients ranged from 2.12 to 3.37 depending upon scale and age group (Community-University Partnership for the Study of Children, Youth, and Families, 2011).

The narrative and scale classifications for the BASC-3 SRP-A, BASC-3 PRS, and the BYI-II are based on *t*-scores obtained using norms. In all three measures, individual subtest *t*-scores were used for comparison (J. S. Beck et al., 2011; Reynolds & Kamphaus, 2015).

### **Analysis**

Statistical analysis consisted of a paired samples *t*-test to analyze pre- and post-TBI measures of cognitive and educational functioning (refer back to Table 3). Correlational analysis was used to determine whether a relationship between preexisting psychosocial, biological, and environmental factors and post-TBI functioning as measured by the BASC-3, BYI-II, post-TBI GPA, attendance, and discipline referrals. Three variables (medical/psychiatric diagnosis, pre-TBI IEP, and Free and Reduced Lunch program participation) could not be analyzed by correlation, as they were coded "yes" and "no" in the data set. Refer back to Table 2 for the descriptive information regarding these three variables. Finally, self-reports of post-TBI functioning and perceived educational and psychosocial needs were provided by the student participants ( $n = 18$ ). Students responded to three prompts about their functioning post-TBI: (a) Please describe changes to your social life since the concussion, (b) Please describe changes to your academic functioning since the concussion (schoolwork homework, grades), and (c) Please describe changes to your mood since the concussion.

## Chapter 4: Results

### Cognitive and Academic Functioning

The first research question sought to explore the relationship between TBI and cognitive and academic functioning of high school students. This was investigated using paired samples *t*-tests to determine the mean difference between pre- and post-TBI cognitive and academic functioning. Psychosocial information was gathered but could not be used for this study due to the small sample size of pre-TBI data available ( $n = 2$ ). Pre-TBI cognitive functioning scores were gathered from shelf data measured on the WISC-IV. Only the FSIQ was reported in one case ( $n = 1$ ). Post-TBI cognitive function scores were gathered from shelf data measured on the WISC-V ( $n = 5$ ) or WAIS-IV ( $n = 3$ ). The relationship between TBI and cognitive functioning on the WISC-IV, WISC-V, and WAIS-IV was not significant. There was some reduction in academic functioning, as measured by GPA, but analyses did not reach significance. Educational functioning was measured as pre- and post-TBI GPA scores ( $N = 20$ ), discipline referrals ( $N = 20$ ), and attendance ( $N = 20$ ). Discipline referrals were found to be significantly higher post-TBI ( $p < .05$ ). See Tables 4 and 5 for additional results.

Table 4

*Paired Samples T-Tests – Cognitive Variables*

<b>Variable</b>	<b>Pre M(SD)</b>	<b>Post M(SD)</b>	<b><i>t</i></b>	<b><i>sig</i></b>	<b><i>Effect Size</i></b>
<b>FS</b>	93.25 (8.48)	90.38 (8.74)	.717	.50	.25
<b>VCI</b>	98.13 (9.15)	98.13 (9.15)	.00	1.00	.00
<b>VC</b>	10.20 (2.58)	9.00 (1.87)	1.12	.32	.50
<b>SI</b>	9.20 (1.09)	10.00 (3.08)	-.51	.64	-.21
<b>BD</b>	8.00 (1.41)	8.00 (1.41)	.00	1.00	.00
<b>MR</b>	9.20 (2.38)	9.40 (2.07)	-.13	.90	-.06
<b>WMI</b>	91.50 (7.94)	94.88 (10.24)	-.77	.47	-.28
<b>DS</b>	8.40 (2.19)	7.60 (2.40)	1.09	.34	.49
<b>PSI</b>	92.25 (8.48)	88.88 (13.82)	.50	.63	.18
<b>CD</b>	9.40 (2.88)	8.40 (1.51)	.72	.51	.33
<b>SS</b>	7.80 (1.30)	9.00 (1.87)	-1.04	.36	.46

Table 5

*Paired Samples T-Tests – Educational Variables*

<b>Variable</b>	<b>Pre M(SD)</b>	<b>Post M(SD)</b>	<b><i>t</i></b>	<b><i>sig</i></b>	<b><i>Effect Size</i></b>
GPA	85.38 (4.47)	82.64(9.51)	1.72	.11	.36
DISCIPLINE	1.67 (4.27)	9.44 (12.4)	-3.23	.005	.82
ATTENDANCE	12.00 (7.83)	14.46 (9.98)	-.941	.36	.27

**Preexisting Conditions**

Pearson product-moment correlations were conducted to determine the strength of the relationship between preexisting psychosocial, biological, and environmental conditions and student psychosocial and educational functioning post-TBI. Psychosocial functioning was measured as pre-TBI GPA ( $n = 15$ ; five students were new to the high school and there was no information regarding GPA or attendance for them), pre-TBI discipline referrals ( $n = 19$ ), and pre-TBI discipline referrals ( $N = 20$ ). Post-TBI student functioning was measured on the BYI-II ( $N = 19$ ), the BASC-3 SRP-A ( $N = 20$ ), post-TBI GPA ( $N = 20$ ), post-TBI discipline referrals ( $N=20$ ), and post-TBI attendance ( $N = 20$ ). Significant correlations were found between pre- and post-TBI GPA. See Table 6.

Preexisting biological conditions were coded as medical/psychiatric diagnoses

and consisted of MDD ( $n = 4$ ), diabetes ( $n = 1$ ), ADHD ( $n = 4$ ), asthma, ( $n = 5$ ), and no diagnosis ( $n = 5$ ). Environmental conditions were coded as students receiving free and reduced lunch ( $n = 5$ ), pre-TBI GPA ( $n = 15$ ), and attendance ( $n = 15$ ).

Medical/psychiatric diagnosis, pre- and post-TBI IEP and Free and Reduced Lunch participant were coded as a “yes” or “no” in the data set and could not be used in the correlational analysis. It is important to note that 75% of the students ( $n = 15$ ) had medical/psychiatric diagnoses prior to TBIs and, of those, 30% demonstrated significant elevation on one or more clinical scale post-TBI. Descriptive information regarding medical/psychiatric diagnosis and post-TBI functioning can be found in Table 7.

The final environmental condition, pre-TBI attendance ( $n = 15$ ), ranged from 0 to 29 days absent prior to TBI and, as such, could be examined for correlation with post-TBI functioning. Significant negative correlations were found between pre-TBI attendance and post-TBI locus of control and anxiety. Results for all correlations can be found in Table 6.

Table 6

*Pearson Correlations for Psychosocial and Environmental Variables*

Variable	BASC-3, SR					BYI-II			Post-TBI GPA	Post-TBI DC	Post-TBI AT
	LC	AN	DP	SE	SR	SC	AN	DP			
Pre-TBI GPA	-.30	.08	-.22	.04	.45	.05	-.25	.68	.85**	-.40	-.44
Pre-TBI DISC	.01	.23	.25	-.09	-.15	-.00	.25	.18	-.40	.64**	.26
Pre-TBI ATD	-.72**	-.52	-.53	.30	.25	.29	-.63*	-.55	.21	-.11	.46

\*p &lt; .05; \*\*p &lt; .01

GPA = Grade Point Average

DISC = Discipline Referrals

ATD = Attendance

LC (BASC-3) = Locus of Control

AN (BASC-3 and BYI-II) = Anxiety

DP (BASC-3 and BYI-II) = Depression

SE (BASC-3) = Self-Esteem

SR (BASC-3) = Self-Reliance

SC (BYI-II) = Self-Concept



Table 7

*Description of Medical/Psychiatric Diagnosis and Post-TBI Psychosocial Change*

<b>Participant #</b>	<b>Medical/Psychiatric Diagnosis</b>	<b>Post-TBI BASC-3 Significant Elevation</b>	<b>Post-TBI BYI-II Significant Elevation</b>	<b>Free Reduced Lunch Participation</b>
<b>1</b>	Diabetes	None	None	No
<b>4</b>	ADHD	Social Stress Interpersonal Relations	None	No
<b>7</b>	Depression	None	Self-Concept	No
<b>16</b>	None	None	None	No
<b>25</b>	Depression	Attention Depression	None	No
<b>29</b>	ADHD	None	None	Yes
<b>31</b>	ADHD	None	None	No
<b>32</b>	Asthma	None	None	No
<b>34</b>	Bipolar	Self-Esteem	None	Yes
<b>36</b>	Depression	None	None	Yes
<b>37</b>	Asthma	Self-Reliance	None	Yes
<b>40</b>	None	None	None	No
<b>42</b>	None	None	None	No
<b>43</b>	Depression	None	None	Yes
<b>44</b>	Lyme Disease	Sense of Inadequacy Self-Reliance	None	No

<b>50</b>	Asthma	None	None	No'
<b>52</b>	None	None	None	No
<b>61</b>	None	None	None	No
<b>62</b>	ADHD	Social Stress Depression Sense of Inadequacy	None	No
<b>64</b>	ODD	None	None	No

### **Educational and Psychosocial Needs**

Educational and psychosocial needs of the post-TBI student were investigated through the use of an informal three-question open response survey completed by 18 participants. Two of the participants left the school district prior to the end of this study. In response to changes in their social lives, students most frequently reported being less social, feeling different and strange, getting nervous when talking to people, and wanting to stay home more than before their TBIs. When asked about changes to their academic functioning, the students reported dropping grades, difficulty focusing, and forgetting information. They also reported an inability to think at times. In relation to changes in mood post-TBI, they most frequently reported a lower mood. They also reported getting agitated and angry easier, and feeling anxious, stressed, and depressed. See Table 8 for percentages of students reporting the most frequently identified concerns.

Table 8

*Most Frequently Reported Problems Identified Through the Survey*

<b>Problem Item</b>	<b>% of Participants (<i>n</i> = 18)</b>
Grades dropped	44.4%
Difficulty focusing	38.8%
Less social	33.3%
Lower mood	27.7%
Gets angry quickly	27.7%
Feel anxious/stressed	22.2%
Forgets information	22.2%
Feel depressed	11.1%
Failing classes	5.5%

## **Chapter 5: Discussion**

Current research is lacking in regard to the educational outcomes of student with TBI. Measures of educational performance, including pre-injury cognitive functioning and academic performance, have not been well described (Arnett et al., 2013). Research is scarce regarding the emotional and psychiatric manifestations following TBI (Ross et al., 2011) and there have been few studies in which students have been invited to share their experiences (Mealings et al., 2012). The purpose of this study was to critically evaluate the cognitive, academic, and psychosocial functioning of 20 high school students post-TBI. Unlike previous studies that often neglect to incorporate students as participants (Boylan et al., 2009), this study collected students' self-reports of experiences post-TBI.

### **Cognitive and Academic Functioning**

The first research question examined the relationship between TBI and high school students' cognitive and academic functioning. Review of the paired samples *t*-tests did not support a significant reduction in cognitive ability post-TBI. This finding is inconsistent with recent research, which generally reports a decrease in cognitive functioning post-TBI (Barlow 2016; Taylor et al., 2003). Parents of children who returned to the classroom full-time after TBI reported long-lasting concerns about their performance, and school-based outcomes are generally poor post-TBI (Arnett et al., 2014; Deidrick & Farmer, 2005). Psychosocial problems can be seen post-TBI, including personality changes, risk taking, and poor awareness of personal limitations (Barlow, 2016; Hale et al., 2011). Findings from this study are consistent with previous research demonstrating a significantly increased number of discipline referrals post-TBI. Equally

important, although not to a level of significance, students' GPAs dropped and attendance to school decreased post-TBI.

### **Preexisting Conditions**

Correlational analyses were used to examine the relationship between preexisting psychosocial, biological, environmental, and educational factors and student functioning post-TBI. Even though several of the biological and environmental variables could not be used in the correlational analysis due to coding issues (medical/psychiatric diagnosis, pre- and post-TBI IEP, and Free Lunch Program participation), it is important to report the demographics of these variables. Of the 20 student participants, 75% had a preexisting medical/psychiatric diagnosis and 25% participated in the Free Lunch Program. This supports Luis and Mittenberg's (2002) research stating that post-TBI students are more likely to have behavior problems, learning disabilities, other developmental disorders, or social disadvantages pre-TBI. Forty percent of the student participants had an IEP prior to TBI, and 65% had an IEP post-TBI. This does not support Glang et al.'s (2010) findings regarding the under-identification of students with special education needs resulting from TBI. A relationship was also found between the students' pre- and post-TBI GPAs and pre- and post-TBI number of discipline referrals. This gives additional support to the negative effect TBI has on students' psychosocial functioning.

Review of environmental factors as measured by pre-TBI attendance indicated a significant negative relationship between students' self-reported locus of control and anxiety. The negative correlation between attendance (number of days absent from school), locus of control, and anxiety indicates that the more days missed, the lower the

student's self-identified level of control and the greater the level of anxiety. This finding is consistent with the research reported by Popoli et al. (2013) and Rosema, Crowe, and Anderson (2012).

### **Educational and Psychosocial Needs**

Finally, this study examined the educational and psychosocial needs of the post-TBI student using a self-report survey completed by the students. Every student (100%) who completed the self-report survey indicated at least one change in their social lives, academic functioning, or moods. When asked about changes to their social lives post-TBI, 33.3% reported that they were less social, some reporting feeling different and strange, getting nervous when talking around people, and wanting to stay home. In relation to their academic functioning, 44.4% reported that their grades dropped, 38.8% reported difficulty focusing, and 22.2% reported forgetting information. The students reported lower moods since TBI (27.7%), feeling anxious and stressed (22.2%), and feeling depressed (11.1%). All of the problems identified by these students have a negative impact on educational and psychosocial functioning. These findings are significant and add to the current research of Barlow (2016), Dams-O'Connor and Gordon (2013), and Rosema (2009). Academic deficits can be found in all domains, and everyday school-based outcomes are poor after TBI (Arnett et al., 2013; Barlow, 2016). The GPAs of the students in this study dropped (pre-TBI GPA  $M = 85.38$  [ $SD = 4.47$ ], Post-TBI GPA,  $81.65$  [ $SD = 9.33$ ]). Barlow (2016) and Rosema (2009) reported a range of psychosocial problems that can be seen following TBI in students. These include anxiety, depression, reduced social participation, agitation, and aggression. Dams-O'Connor and Gordon (2013) reported generalized changes to mood, difficulty managing

anger, and anxiety post-TBI. Of the student participants, 30% self-identified a level of significant elevation on the BASC-3 or BYI-II post-TBI. The areas include social stress, interpersonal relations, attention, depression, self-esteem, self-reliance, sense of inadequacy, and anxiety. This finding adds to the current research on the negative academic and psychosocial impact of TBI on the school aged individuals.

### **Limitations**

This was a pilot study conducted in one high school building and, therefore, the number of students with preexisting cognitive and psychosocial data was limited. In addition, the participants in this study were students who reported TBIs to the school nurse. There is a significant under-identification of children with TBI and a need for a more systematic method for TBI identification to ensure that the finding of this study generalizes to all TBI students.

Another limitation of this study was that the original design planned to use student participants as their own control in a pre-/post-TBI comparison of psychometric data. This design would reduce between-subject variance, increasing statistical power. Unfortunately, it was impossible to obtain pre-TBI scores other than the WISC-IV scores of eight students. Pre- and post-TBI WISC-IV, WISC-V, and WAIS-IV score differences did not reach statistical significance and were, essentially, similar. The value of this study lies not in its negative results but in the lessons learned in conducting this type of study. The study conception was overly optimistic. It was limited by the unavailability of pre-TBI testing to any useful degree for psychosocial factors. It was also impossible to perform adequate correlational studies of environmental and risk factors.

Additional study limitations include the small sample size, the lack of adequate

medical information including diagnosis and brain site of the injury, and the varied time between participants' injuries and testing. Powerful statistical techniques such as *t*-tests and Pearson product-moment correlations require normal distributions of data and interval or ratio scaling, which was lacking for many of the variables being considered.

Even acknowledging the limitations of this study, it is necessary to question why no cognitive group effects of TBI were found. There are several possibilities:

1. The sample of students with TBI histories was limited to those with mild-TBI, who were able to return to school.
2. The time between injury and testing was not controlled.
3. The WISC-IV and WISC-V FSIQ factor scores are too general to detect subtle cognitive deficits.
4. Affected students may have experienced initial cognitive deficits but have recovered.
5. Specific medical/psychiatric diagnoses and areas of brain injuries were unavailable.

Of additional note, the investigator is the case manager for all the students in the study, which may have led to greater participation and may not generalize to the full population of students with TBI. Additionally, the survey used to measure the students' self-reported educational and psychosocial functioning post-TBI was designed for this study and, therefore, does not have reliability and validity with other measures.

Psychometrically sound measures of psychosocial functioning (e.g., BASC-3, BYI-II) were collected post-injury, but are designed to measure current functioning and limited pre-injury data were available. The survey designed for this study, although lacking



psychometric data, was to provide information regarding students' perceptions of their change in functioning since injury, an area of the literature that is lacking.

### **Clinical Implications**

This study revealed important information for those working with post-TBI students. As indicated by the findings from this study and current research, students are reporting academic and psychosocial needs that are not always identified through psychometric assessments. This study also demonstrated a reduction in GPA post-TBI, an increase in difficulty focusing and forgetting information, and lower mood with higher levels of anxiety and stress. In addition, the students reported feeling depressed and quick to anger. Thirty percent of the student participants self-identified a level of significant elevation on the BASC-3 or BYI-II. These results support the idea that students with TBI require a more comprehensive tracking system than other students, as they display behaviors that are significantly different from other students (Glang et al., 2004). It is imperative that the schools follow these students closely. Upon return to school, each post-TBI student should be discussed in the child study team or relevant multidisciplinary meeting. A case manager should be assigned to each student to follow his or her academic and psychosocial and progress weekly. Upon receipt of permission from the parent and student, information gathered should be disseminated to the relevant teaching staff working with the student.

To further support school personnel's understanding of functioning post-TBI, the school psychologist, guidance counselor, or other relevant school staff should offer a concussion seminar to the school faculty, affiliated sports and coaching staff, and parents to educate them on the magnitude and negative outcomes of TBI. There is currently a

culture of non-disclosure relating to concussions. It is the responsibility of professionals to educate and encourage students to report all head injuries and teach parents and school staff the signs and symptoms of a concussion as a proactive measure.

### **Future Research**

In addition to clinical implications, this study provides considerations for several research directions. As a primary issue with this study is its small sample size, future studies should utilize a larger sample size. The WISC-IV, WISC-V, and WAIS-IV assess cognitive function globally; however, specific neuropsychological testing assesses the subcomponents of cognitive processes and would likely provide more targeted information. Longitudinal research examining site of impact and cognitive, academic, and psychosocial function over time would be helpful. Additionally, it would be interesting to further explore the correlation between participants' preexisting medical and psychiatric diagnoses and post-TBI psychosocial functioning. Finally, the development of a psychometrically sound post-TBI survey, identifying real-time needs of students would be helpful for those in the field to use and track the students' levels of functioning. It is important to continue this line of research because TBI affects students cognitively, academically, and psychosocially and is currently not well understood.

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## **Appendix A**

### **Script for Recruitment Phone Call**

Hello, my name is Mary Ellen (Meg) Henigan. I am the school psychologist at the high school. Today, I am calling you as a pre-doctoral student from Philadelphia College of Osteopathic Medicine. I am recruiting candidates for a study I am performing on the effect of concussion on high school students' academic, emotional, and social functioning. Your son/daughter meets criteria for my study because he/she has had a concussion. I am inviting your son/daughter to participate in the study. It will entail one visit. He/she will be asked to complete two self-report measures regarding his/her social and emotional functioning and asked a few additional questions about his/her experience following concussion. This should take about 30 minutes. If your son/daughter had cognitive testing before the concussion, I would like to re-administer the cognitive testing for comparative purposes. This will take an additional hour. I will try to do this in one visit, but depending on your child's academic schedule, may need to break the testing into two sessions. My hope is to learn more about the effects of concussion on the student's academic functioning, but more importantly, regarding the effects on mood and social functioning as reported by the student. I am going to ask you as the parent/guardian to give input by way of a background developmental history form and one parent-report measure. If you are comfortable with your son/daughter participating, I will schedule a meeting to review the study further with you and your son/daughter.

## **Appendix B**

### **Script for Introduction to Consent Meeting**

Hello, my name is Mary Ellen Henigan (Meg). We are having this meeting today so I can explain the study I am performing. I am recruiting candidates for a study I am performing on the effect of concussion on high school students' academic, emotional, and social functioning. Your son/daughter meets criteria for my study because he/she has had a concussion. It will entail one visit. He/she will be asked to complete two self-report measures regarding his/her social and emotional functioning. This should take about 30 minutes. If your son/daughter had cognitive testing before the concussion, I would like to re-administer the cognitive testing for comparative purposes. This will take an additional hour. This will be one visit. My hope is to learn more about the effects of concussion on the student's academic, but more importantly, regarding the effects on psychosocial functioning as reported by the student. I am going to ask you as that parent/guardian to give input by way of a background developmental history form and one parent-report measure.

**Appendix C****Rating Forms and Background/Developmental History Form****Student Input**

Please describe changes to your social life since the concussion.

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Please describe changes to your academic functioning since the concussion (schoolwork, homework, grades).

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Please describe changes to your mood since the concussion.

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**Background/Developmental History Form**

Your cooperation in completing this form is greatly appreciated.

The deidentified information will be used as part of this study. If you have any questions, please contact:

Meg Henigan, School Psychologist, Doctoral Intern.....610-359-4242

Child's Number \_\_\_\_\_

Child Lives With?

- Birth Parents                      • Foster Parents                      • One Parent \_\_\_\_\_
- Adoptive Parents                      • Parent and Step-Parent                      • Other \_\_\_\_\_

Is there another language other than English spoken in the home?   • Yes   • No

If yes, which one(s)? \_\_\_\_\_

Please check all that apply:   • Child speaks language                      • Child understands language

Who speaks the language in the household? \_\_\_\_\_

**Family Information at Child's Primary Residence**

Parent/Guardian's:

Level of Education:

• Some high school • Completed high school • Attended 2-yr college • Associate's Degree • Attended 4-yr college • Bachelor's Degree • Master's Degree • Doctorate Degree

Occupation \_\_\_\_\_

Parent/Guardian's:

Level of Education:

• Some high school • Completed high school • Attended 2-yr college • Associate's Degree • Attended 4-yr college • Bachelor's Degree • Master's Degree • Doctorate Degree

Occupation \_\_\_\_\_

Has your child experienced any major life stressors (divorce, death in the family, accidents, etc.)? • No • Yes (please explain)

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Are there any current stressors in the home that would affect your child's performance in school or your child's ability to complete homework assignments?

- No
- Yes (please explain)

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### Family Health History

We are interested in whether (to the best of your knowledge) anyone in your child's family has or had any of the conditions listed below. Please put an "X" in the column(s) that apply. Include parents, siblings, half-siblings, and grandparents in the biological family category. Include aunts, uncles, and cousins in the extended family.

	Biological Family	Extended Family
Learning Disability		
Attention Deficit/ Hyperactivity Disorder		
Trouble learning to read		
Speech/language impairment		
Trouble with math		
Trouble with writing		
Repetition of a grade		
Intellectual Disability		
Behavior problems in school		

Serious illness (specify)		
Seizures		
Depression		
Incarcerations		
Institutionalization (for mental health issues)		
Suicide or attempted suicide		
Substance abuse or alcoholism		
Other conditions which may impact learning or behavior (specify)		

Comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Child's Medical History

Pregnancy:

Length of pregnancy \_\_\_\_\_ Duration of labor \_\_\_\_\_ hrs.

Delivery • normal • caesarian

Medical complications:

During pregnancy \_\_\_\_\_

During birth \_\_\_\_\_

Following birth \_\_\_\_\_

Birth weight \_\_\_\_lbs. \_\_\_\_oz. Need for respirator or incubator? • Yes • No

Developmental Milestones	Approx. age achieved	Don't Remember	Not yet
Sat Upright	_____	_____	_____
Walked alone	_____	_____	_____
Spoke first word	_____	_____	_____
Spoke in 2 to 3 sentences	_____	_____	_____
Toilet trained (daytime)	_____	_____	_____
Toilet trained (nighttime)	_____	_____	_____

Gross motor coordination development • Good • Average • Below Average

Fine motor coordination development • Good • Average • Below Average

Handedness • Right • Left • Mixed

Does the child wear corrective lenses? • Yes • No

Does the child use a hearing aid? • Yes • No

Does the child use other adaptive devices? • Yes • No

Has this child ever

Been hospitalized? • Yes • No

Had a head injury? • Yes • No

**Diagnosed Concussion?**

**School Modifications and Accommodations?**

Attendance ☐

- Physical Needs ☐
- Workload ☐
- Test Taking ☐
- Physical Activity ☐

Please list or attach documentation:

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### Non- School Recommendations?

Cognitive Rehabilitation? 

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Other Types of Therapy? 

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- |                                 |       |      |
|---------------------------------|-------|------|
| Had a seizure?                  | • Yes | • No |
| Been poisoned (including lead)? | • Yes | • No |
| Had speech problems?            | • Yes | • No |
| Had hearing problems?           | • Yes | • No |

Had allergies?	• Yes	• No
Had many ear infections?	• Yes	• No
Had asthma?	• Yes	• No
Had vision problems?	• Yes	• No
Had poor coordination?	• Yes	• No

Please describe any “Yes” responses. \_\_\_\_\_

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Has this child had previous psychological, psychiatric, or neurological evaluations?

• No                      • Yes (when and where?)

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Significant past illness(es)

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**Present Medical Status**

Illnesses your child is currently being treated for \_\_\_\_\_

\_\_\_\_\_

Medication(s) your child is currently taking \_\_\_\_\_

\_\_\_\_\_

Physical problem(s) your child reports \_\_\_\_\_

\_\_\_\_\_

Describe any past or present eating problems \_\_\_\_\_

\_\_\_\_\_

Describe any past or present sleeping problems \_\_\_\_\_

\_\_\_\_\_

**Child's Educational Background**

Does your child like school?      • Yes      • No

Is attendance/tardiness a problem?      • Yes      • No

If yes, please explain the problem: \_\_\_\_\_

\_\_\_\_\_

**Thank you for your cooperation in completing this form!**